A Review of the Acanthametropodinae with a Description of a New Genus

(Ephemeroptera: Siphlonuridae)

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The subfamily Acanthametropodinae is one of the least known mayfly groups and a reasonable understanding of the taxon is available now for the first time. The subfamily was established by Edmunds (in Edmunds, Allen and Peters, 1963) for *Acanthametropus* and an undescribed genus. These forms were known only as nymphs. *Siphluriscus chinensis* Ulmer (1920) was the first acanthametropodine to be described, and it remains known only from the six adult specimens from China used in the original description. *Acanthametropus nikolskyi* Tshernova (1948) was described from an immature nymph from the Amur River. Burks (1953) described *Acanthametropus pecatonica* (as *Metreturus*) from two nymphs collected in Illinois in 1926 and 1927. *Metreturus* was erected as a new genus only because Tshernova's paper was then unknown to American mayfly workers. Edmunds and Allen (1957) synonymized *Metreturus* Burks with *Acanthametropus* Tshernova. Both Tshernova and Burks placed *Acanthametropus* as allied to *Ametropus*, but Edmunds and Traver (1954) and Edmunds and Allen (1957) placed the genus in the Siphlonuridae. Edmunds, Allen and Peters (1963) recorded *Acanthametropus* from the Savannah River, Georgia-South Carolina, based on three nymphs. Comparison of the three Savannah River and two Illinois specimens does not allow a decision as to whether or not there is more than one species in the United States.

Tshernova (1967) described the Lower Jurassic *Stackelbergisca* from a well preserved nymph from Siberia and an associated wing fragment. Both have characters of the extant acanthametropodines. The fossil nymph indicates that the legs are all directed posteriorly and the mouthparts are for carnivorous feeding. The fork of MP is deep and asymmetrical in the wing fragment; this is a character of Acanthametropodinae, but it is not exclusive to that subfamily.

The genus *Analetris*, described below, was found first in 1947 as a partial nymph in the stomach of a fish collected from the Green River at Hideout Canyon (Edmunds, 1957). One nymph subsequently

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was collected by G. R. Smith and G. G. Musser from the Green River at Buckboard Flats, Sweetwater Co., Wyoming in July 1959. Since 1947 many hours were expended in an effort to collect additional specimens from the Green River and its larger tributaries. In 1962–63 the Green River was inundated with water stored behind Flaming Gorge Dam and hope for additional specimens dimmed. In 1968 the junior author was successful in locating a population in a stretch of the Blacks Fork River from near Granger, Wyoming, to the crossing of the Blacks Fork River at Interstate Highway 80, about 7 miles east of Little America. He was able to rear one subimago ♂ which enabled us to recognize that *Siphluriscus* was an Acanthametropodinae. It is not known how many miles of the Blacks Fork River support *Analetris*, but it is relatively short because in many summers the river is almost dry before it reaches Flaming Gorge Reservoir. Most of the river is not readily accessible, but it is in increasing danger from oil well drilling, agricultural development, dam building and pollution. In fact, five additional collecting attempts have produced no more specimens. Lehmkuhl (1970) collected a series of nymphs of the same species in the South Saskatchewan River. This river is also in danger from pollution.

In the Acanthametropodinae, then, there are about 55 known specimens of 4 genera, of which 7 are imagos and subimagos. *Analetris* is the best represented genus but its known habitats are endangered. More than 40 miles of the Green River where *Analetris* presumably occurred have already been submerged behind Flaming Gorge Dam. The failure to collect more specimens is a result of a habitat in which it is difficult to collect, the shy and extremely fast swimming behavior of the nymphs, and inadequate collecting techniques.

Subfamily Acanthametropodinae

Adult.—Tornus of forewings near mid length; vein MP deeply forked; anal field elongate. Hind wings ½ or more as long as fore wings; vein MP deeply forked, base less than ¼ as long as fork. Fore tarsi of ♂ 2½ to 3 times as long as tibiae. Subgenital plate of ♂ deeply excavated medially. Terminal filament at least 2 mm long.

Nymph.—Mouthparts of carnivorous type; mandibles with long sharp incisors; maxillae with fang-like spines; third segment of labial palpi reduced. Legs directed posteriorly when dead (or when swimming). Fore and middle pairs of legs with femora broadest in basal one-third; tarsi ca. ½ as long as tibiae; claws long, varying from ½ to 1½ times as long as tarsi; hind legs with margins of femora subparallel, femora ⅙ or less as wide as long; claws longer than tibiae and tarsi combined; tibiae, tarsi and claws bowed inward. Posterolateral projections present on abdominal segments 1–9. Cerci with long setae on

mesal margins; terminal filament with long setae on both lateral margins.

Keys to the two genera known as adults and two known as nymphs are not necessary. Adults of *Analetris* have the three caudal filaments subequal in length while in *Siphluriscus* the terminal filament is much shorter than the cerci. *Acanthametropus* nymphs have conspicuous lateral projections on the head, prothorax and metathorax and a median tubercle on each abdominal tergum; these are not found in *Analetris*. It is possible that *Siphluriscus*, known only from adults, and *Acanthametropus*, known only as nymphs, represent a single genus.

Analetris Edmunds, new genus

SUBIMAGO ♂.—Eyes with ommatidia of fairly uniform size. Fore wings (Fig. 2) with fork of MA about ¾ as long as base; vein MP deeply forked, the fork over 4 times as long as the base; CuA connected to hind margin by 5 to 7 short crossveins (one forked on one wing, additional intercalary on one wing not attached basally). Hind wings (Fig. 3) more than 50% as long as forewings; MP deeply forked. Tarsi more than twice as long as tibiae; claws of each pair dissimilar, one rounded apically, one sharply hooked. Penes fused, rounded apically; forceps base deeply V-shaped (Fig. 7). Terminal filament subequal in length to cerci.

NYMPH (Fig. 1).—Head without lateral or frontal projections; maxillary palpi present. Fore femora broadest about ⅓ distance from base. Abdomen without median tubercles on terga. Caudal filaments subequal in length. Gills with margins entire, and with two ventral (posterior) smaller lobes (Fig. 4).

TYPE SPECIES.—*Analetris eximia* Edmunds, n. sp.

Etymology. From Greek, without a molar (grinder).

Analetris eximia Edmunds, new species

Genus et species incertus, Edmunds, 1954:64

Genus et species novum, Edmunds and Musser, 1960:113

Undescribed genus, Edmunds, 1957:23; Edmunds, Allen and Peters, 1963:10; Lehmkuhl, 1970:183.

SUBIMAGO ♂.—Length: body 12; wings 12 mm. Head pale, with pair of brown stripes between eyes; lower portion of eyes gray, upper portion orange. Prothorax yellowish brown, notum slightly darker. Mesothorax yellowish brown, with light brown stripe on each side between median line and inner parapsidal furrows of the notum, continuing to scutellum; medium brown along outer parapsidal furrows to wing bases, thin darker brown stripe along anterolateral margins of mesocutellum; medium brown marks at base of wings. Metathorax yellowish brown, dark brown streak on each side near apex of scutellum; medium brown marks at wing bases. Wings pale, longitudinal veins light brown,

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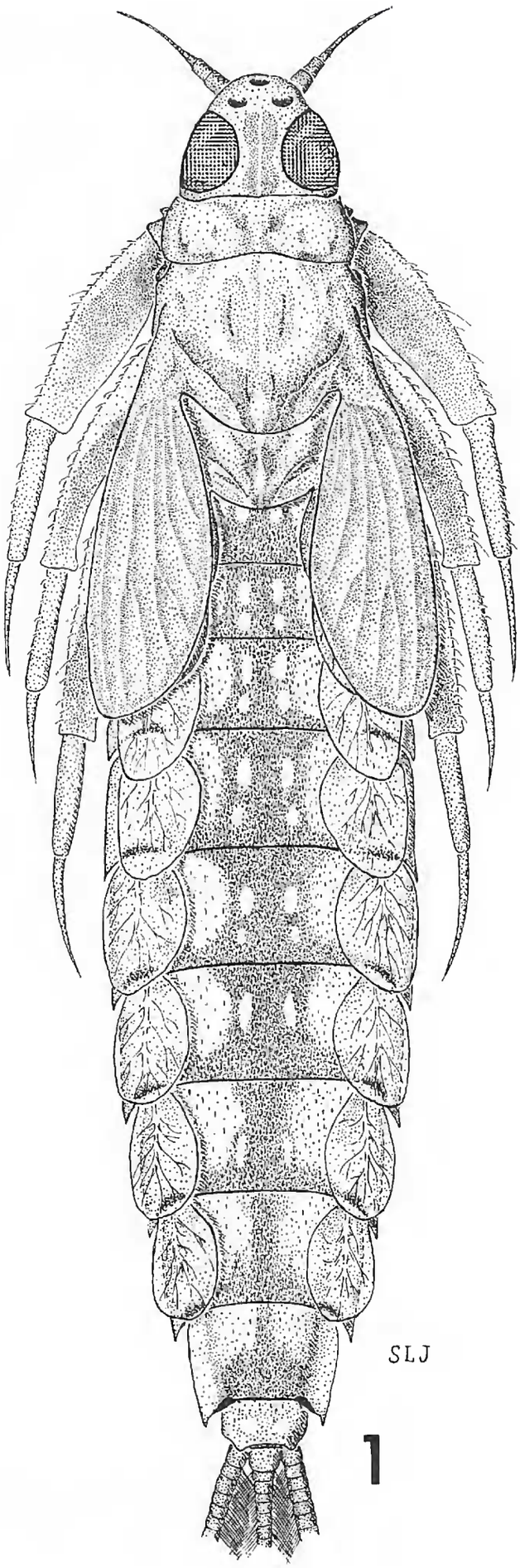
FIG. 1. *Analetris eximia*, nearly mature nymph, dorsal view.



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cross veins pale brown. Fore and hind tibiae and tarsi (Figs. 5 and 6). Legs yellowish brown; tibiae, tarsi and apex of fore femora medium brown; middle and hind legs with tibiae and tarsi darker than femora. Apex of each tarsomere narrowly ringed in brown.

Abdomen largely pale yellowish brown except for tergum one; tergum one largely medium brown, lateral margins pale, pale transverse lunar mark on anterior margin each side of midline, and pale spot in middle area of tergum on each side of midline; markings on terga 2 to 10 rather similar to those same segments of nymphs (Fig. 1), but more diffuse; median brown band bounded laterally by darker streaks; diffuse brown triangles lateral of median stripe, bases on posterior margins, triangles not reaching lateral margins of terga; darker line along posterior margin of each tergum. Sterna pale. Male genitalia (Fig. 7). Caudal filaments light brown at base, becoming paler apically.

MATURE NYMPH.—Length: body 15, caudal filaments 4 mm. Color pale with markings generally light brown (Fig. 1). Head pale with pair of brown stripes between eyes from hind margin to ocelli; ocelli gray; apices of mandibles and maxillae brown. Pronotum with narrow transverse brown stripe near front margin, interrupted at midline; broader transverse stripe near middle of segment, interrupted at midline and reaching halfway to margin; smaller brown spot near margin on each side; sternum pale. Mesonotum pale with longitudinal brown stripe laterad of inner parapsidal furrow on each side; stripes on each side laterad of outer parapsidal furrow, extending to wing pad base; wing pad bases largely pale; apex of scutellum brown; pleura and sternum pale. Metathorax pale except for complex brown markings on metascutellum. Legs pale with diffuse brown band near apex of femur; this band very pale on middle and hind pair of legs.

Each abdominal tergum with wide brown median stripe containing four pale dots, and with brown triangles on each side, their bases on hind margin; dark brown streak near posterolateral corner of each tergum and dark brown spot near each gill insertion. Sterna pale. Gills pale, washed with brown dorsally on inner half. Caudal filaments pale basally, becoming increasingly darker brown toward apices.

Holotype subimago ♂ and nymphal exuvium of same, BLACKS FORK RIVER AT INTERSTATE HWY. 80, 7 MI. E. OF LITTLE AMERICA, SWEETWATER COUNTY, WYOMING, collected 3 August 1968, emerged 9 August 1968, R. W. Koss and W. P. McCafferty, in collection of University of Utah. Paratopotypes: 5 nymphs, 6 July 1968, R. W. and D. Koss; 3 nymphs, 3 August 1968, R. W. Koss and W. P. McCafferty; 20 nymphs, 18 July 1968, R. W. Koss. Paratypes: Wyoming: Sweetwater Co.; Blacks Fork River at Granger, 4 nymphs, 3 August 1968,

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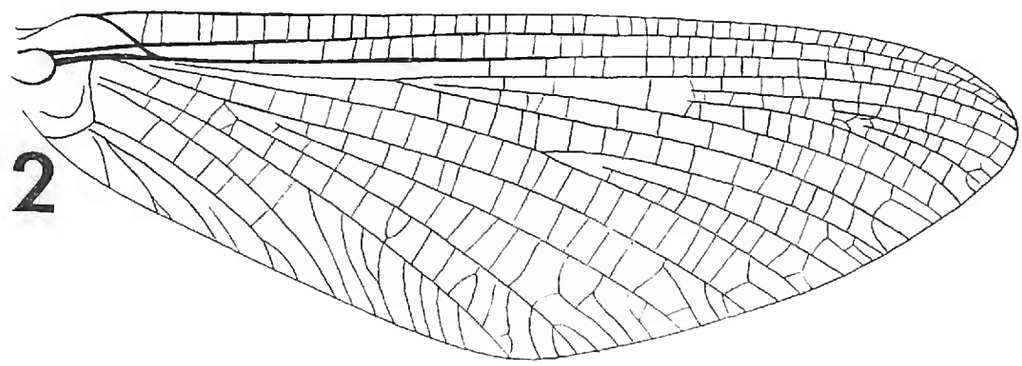
FIGS. 2–7. *Analetris eximia*. (FIGS. 2,3 and 5 to 7. subimago ♂; FIG. 4. nymph). FIG. 2. Fore wing. FIG. 3. Hind wing. FIG. 4. Gill 4, dorsal view. FIG. 5. Fore tibia, tarsus and claws. FIG. 6. Hind tibia, tarsus, and claws. FIG. 7. Genitalia, dorsal view.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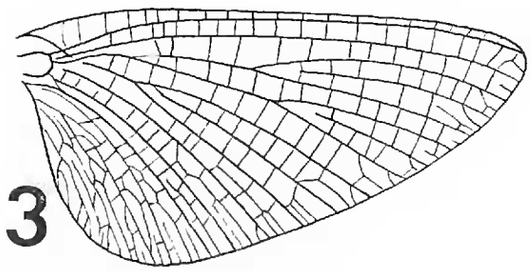
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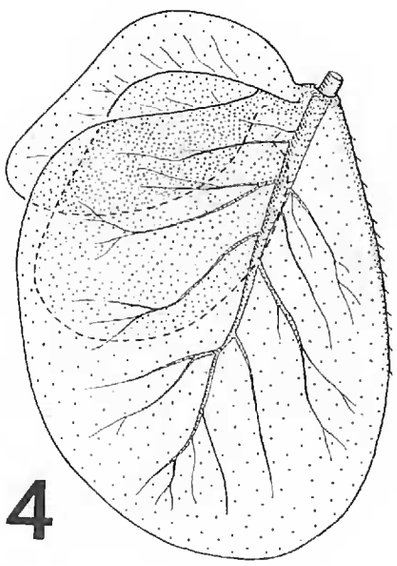
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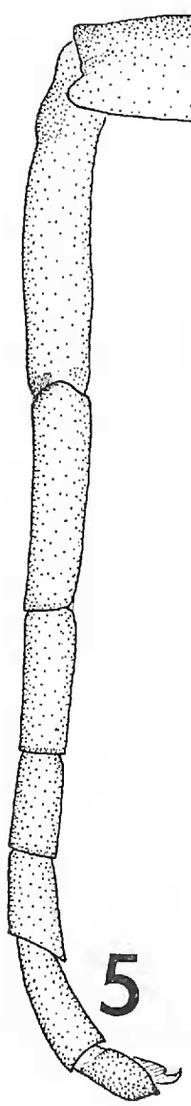
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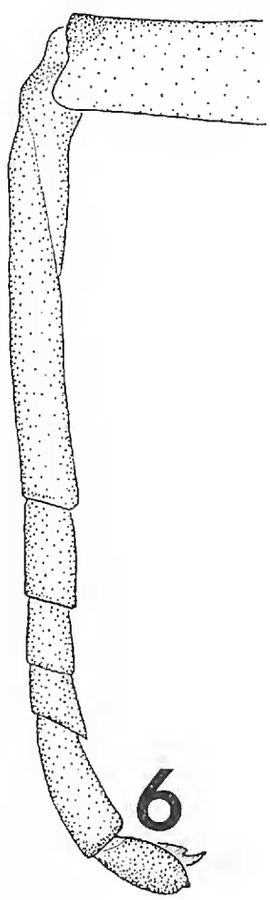
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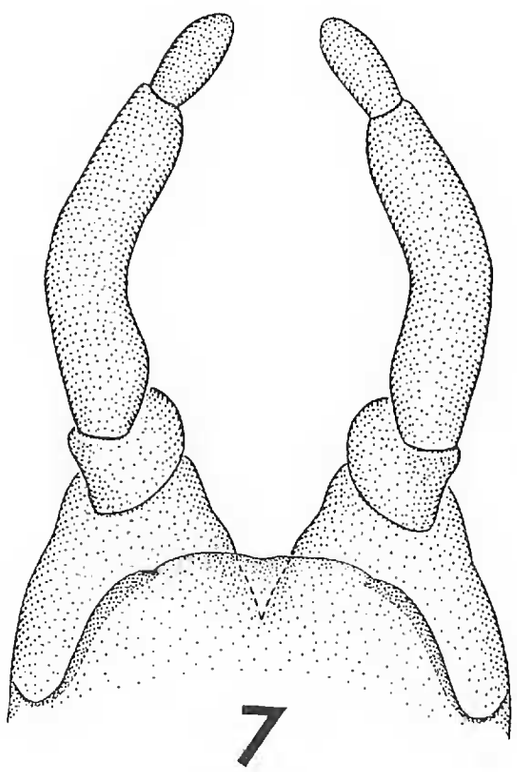
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R. W. Koss and W. P. McCafferty; Green River at Buckboard Flats, 1 nymph, 16 July 1959, G. W. Smith and G. G. Musser. Utah: Daggett Co.; Green River at Hideout Canyon, 1 nymph, 3 September 1947, G. F. Edmunds, Jr. Saskatchewan: South Saskatchewan River at Lemsford Ferry, 12 July 1970, D. M. Lehmkuhl, 10 nymphs, one in Canadian National Collection, one in University of Utah collection, others at University of Saskatchewan.

One or more paratypes in collections of R. W. Koss, Florida A & M University, California Academy of Sciences, Purdue University and Institute Royal des Sciences Naturelles, Brussells; others at University of Utah.

Notes on the Habitat and Biology of Nymphs

Analetris nymphs are known only from warm rivers having a constantly shifting sand substrate. Other insects found in this habitat are the nymphs of the mayflies *Pseudiron* and *Ametropus* and the dragonflies *Ophiogomphus* and *Gomphus*. The type locality in the Blacks Fork River is slow-moving (approximately 0.5 ft./sec. on the surface), shallow and alkaline. The river is mostly 1–2 feet deep in mid-July and fairly clear. Following rains and in the spring it is milky to muddy and several times the summer volume. At mid-day 17 July 1968 the water temperature was 21° C (71° F). The water temperatures at the Green River collecting sites varied from 19° to 23° C (66° to 74° F) in summer and fall.

The nymphs were most abundant in the fine-grained sand deposits on the downstream end of deposition zones on the inside curves of the meandering river. They anchor themselves on the shifting sand substrate by burying the legs in the sand nearly to the base of the tibiae by rapidly shifting the body forward and backward. The front legs are positioned slightly laterigrade in a somewhat anteriorly directed "pinching" position, while the middle and hind legs are perpendicular to the substrate surface. Frequently the nymphs rapidly fan the gills, excavating sand from below and around the body to create a slight depression in the sand. In nature sand probably buries the nymphs, and they were observed to remain buried in a laboratory aquarium with circulating water. When the water was circulating slowly they were observed to do a "push-up" movement, undulate the abdomen, free themselves of sand, and fan the gills, after being buried for 2–4 minutes. These reactions are presumed to be a response to inadequate oxygen available to the nymphs. In nature such movements may be necessary during low nighttime oxygen concentrations.

Nymphs survived longer in circulating water than in continually aerated standing water.

The nymphs often move over the sand searching the surface, perhaps for suitable substrate or for food, with the maxillary palpi. The mouthparts are obviously adapted for carnivorous habits and in the lab they fed on red-blooded Chironomidae, eating them whole.

The nymphs swim rapidly, and they readily avoided hand screens, rapidly dragged dip nets and a rapidly moved deep-bag net. The most effective collecting device proved to be a net with an opening 3 feet wide by 1 foot high, and a bag 4 to 5 feet deep. The net was used in shallow water, and it was hand held on the substrate. The collector's foot was used to "herd" or direct the specimens downstream into the net. This was best accomplished by dragging the foot along the bottom from an upstream position to a downstream one, starting from one side of the net opening and gradually moving over the other side. The net was then raised and shifted over to a new, undisturbed area, and the process repeated.

When the same net was staked out in the river overnight as a driftnet, it proved ineffective for collecting nymphs of *Analetris* and *Ametropus,* but an excellent collecion of *Pseudiron* nymphs was made.

Lehmkuhl (1970, and personal communication) was able to collect *Analetris* by rapidly moving a drag net upstream over the substrate surface.

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SCIENTIFIC NOTE

Mass movements of *Nymphalis californica* (Boisduval) in the San Francisco Bay area during 1971 (Lepidoptera: Nymphalidae).—The California Tortoise Shell butterfly undergoes periodic or sporadic population outbreaks and mass movements which have been called migrations in the literature. The last time such an event took place in the San Francisco Bay area was in 1959–1960 when several aggregations of the butterflies were observed flying in spring and under bark in winter in Marin County, followed by tremendous populations developed in June the following season. During intervening years the species is scarce and may not be a continuous breeding resident here.

During October 1971, I observed movements of *N. californica* in the Berkeley Hills, Alameda County, at a site above the Caldecott Tunnel (about 1,400 feet elevation). On 5 October, a smoggy day with temperatures in the 80's °F., the butterflies passed to the southeast (along the axis of the hills) at a steady 2/minute on a 50 foot sighting line, between 11:45 and 12:05 p.m. (P.S.T.). Most flew 3–8 feet above the ground over the roadway which forms a corridor through the trees at this point; a few flew circuitously or eastward through the trees. However, on the open ridge east of the trees none could be seen heading eastward, that is off the ridge axis. 7 October was cooler (77° maximum in Oakland) with an easterly breeze. The *Nymphalis* were less numerous and less directional in their activities, with 45 sighted in aggregated 30 minutes surveillance beween 11:50 and 12:40 p.m., and only 75% moved in a southeasterly or easterly direction. On 12 October, another warm, smoggy day (90° in Oakland), the flight was greatly increased, with a census of 392 during periods totaling 35 minutes (11/minute) between 11:30 and 12:15 p.m. Counts were made on the road and on open ridge knolls to the east and all individuals moved southeasterly despite a stiff northeasterly breeze. The site was revisited between 11:30 to 1:00 p.m. on 14 and 28 October, which were clear but much cooler days, and no *N. californica* were present.

Ten specimens were taken on 12 October and eight proved to be females, the ratio perhaps in part the result of sampling error if males are faster, more erratic fliers. Other butterflies flying in the vicinity included *Precis coenia* (Hübner), *Adelpha bredowi* (Geyer), *Vanessa carye* (Hübner), *Danaus plexippus* (L.), and *Colias eurytheme* (Boisduval). All but *P. coenia* were present in low numbers and none showed any tendency for directional movement.

Sightings of individual *N. californica* were made in Walnut Creek, Contra Costa County and in Berkeley on the University of California campus, during the period of 5–12 October, by John Hafernik. Both localities are non-resident sites for this species.—J. A. POWELL, *University of California, Berkeley, 94720.*